

# Fatal school shootings and the epidemiological context of firearm mortality in the United States

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**Keywords:** school shootings, rampage shootings, shooting massacres, mass shootings, gun violence, firearm homicides

**Background:** The December 14, 2012 mass shooting at Sandy Hook Elementary School in Newtown, Connecticut, USA, vaulted concerns regarding gun violence to the forefront of public attention. This high-visibility incident occurred within the epidemiological context of U.S. firearm mortality that claims more than 88 lives daily.

**Methods:** National epidemiologic data on firearm deaths over two decades were analyzed along with data registries on school shootings in order to place the tragedy at Sandy Hook in perspective. School shootings were classified as random or targeted.

**Results:** The U.S. has the highest rates of firearm deaths, suicides, and homicides among the world's 34 "advanced economies." Seventy percent of U.S. homicides and more than 50% of U.S. suicides are committed using a firearm. U.S. firearm homicide rates first declined, and then stabilized, during the past 23 years, 1990–2012. "Shooting massacres" in school settings, a new phenomenon within the past 50 years, are extremely rare events. Over 23 years, 1990–2012, 215 fatal school shooting incidents resulted in 363 deaths, equivalent to 0.12% of national firearm homicides during that time period. Most episodes were "targeted" shootings in which the perpetrator intentionally killed a specific individual in a school setting. Only 25 of these 215 events (11.6%) were "random" or "rampage" shootings, resulting in 135 deaths (0.04% of national firearm homicides). Among these, just three shooting rampages – Columbine High School, Virginia Tech University, and Sandy Hook Elementary School – accounted for 72 (53.3%) of these 135 deaths. The frequency of random/rampage shooting incidents in schools has remained within the narrow range of 0 to 3 episodes per year.

**Conclusions:** Each year, more than 32,000 Americans die by firearms and more than 70,000 are wounded, representing a volume of preventable deaths and injuries that the U.S. government describes as a "public health crisis." School massacres, such as Sandy Hook, occur periodically, galvanizing public reaction and bringing forth a collective call for intervention. Epidemiological analyses position these infrequent, but uniquely compelling, incidents within the broader national patterns of gun violence. The intention is to inform the selection of a balanced, comprehensive set of effective remedies to address the daily death toll from firearm suicides and "targeted" firearm homicides that account for more than 99% of firearm fatalities as well as the rare, random, and sporadic rampage shootings in school or community settings.

## Introduction

On December 14, 2012, Sandy Hook Elementary School (456 students in grades kindergarten–fourth grade), Newtown, Connecticut, was the scene of a shooting massacre.<sup>1</sup> In less than 12 minutes, armed with a Bushmaster XM15-E2S rifle, the 20-year-old perpetrator, Adam Peter Lanza, blasted his way into the locked school building and killed 20 first-grade students and six adult staff, firing off 50 to 100 rounds with his semi-automatic weapon. Most victims died from multiple gunshot wounds inflicted at close range using frangible ammunition that fragments upon impact. As police entered the school responding to the incident, Mr. Lanza killed himself with a handgun. Had officers not arrived on the scene swiftly, Mr. Lanza had sufficient ammunition in large-capacity magazines to expeditiously

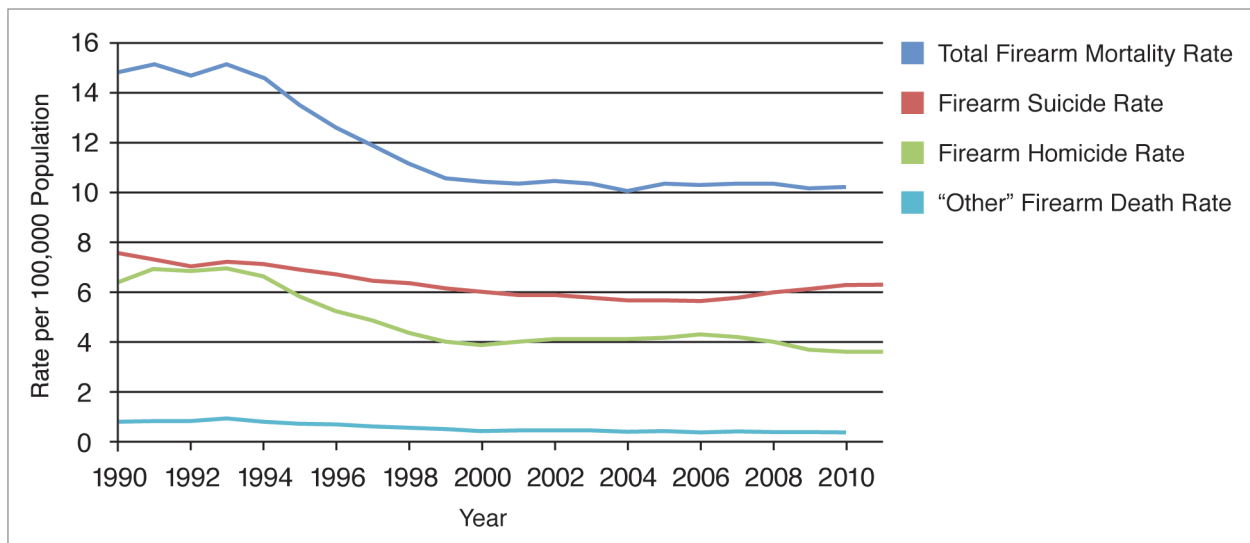
kill dozens or hundreds more students and teachers. Given the documented motivation of some shooters to attempt to exceed previous body counts,<sup>2</sup> Mr. Lanza may have aspired to out-kill Norwegian gunman Anders Breivik who stalked, shot, and killed dozens of unarmed youth and young adults at the Norwegian Labour Party's summer camp on Utøya Island in July 2011.<sup>3,4</sup>

The Sandy Hook Elementary School shooting was a galvanizing and polarizing event, bringing forth strident calls for gun control and mental health reform.<sup>5</sup> President Barack Obama became personally involved, making repeated visits to Newtown, empaneling a special investigative committee, spearheading progress toward implementation of 23 gun violence reduction executive actions,<sup>6</sup> packing the chambers of Congress with survivors of gun violence as he delivered his 2013 State of the Union address,<sup>7</sup> and actively involving family members of the Sandy

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**Figure 1.** United States annual firearm mortality rates per 100,000 population, 1990-2011.

Hook victims as advocates for legislation to address this national problem.<sup>8</sup> Nevertheless, the forceful political rhetoric and extensive media coverage of the issue of mass violence has yet to result in policy or behavioral change.<sup>5,9,10</sup>

We have written separately<sup>5</sup> about the “tipping point” nature of the Sandy Hook Elementary School shooting and the psychological and social media ramifications.<sup>11</sup> In the present article, we examine school-based shooting massacres from an epidemiological vantage, exploring the national context of firearm mortality. The purpose is to simultaneously demonstrate both the importance, and the exceptional nature, of school-based rampage shootings.

#### National patterns of firearm violence and mass shooting events

Gun violence riddles U.S. inner cities and rural areas.<sup>12</sup> In 2011, the most recent year for which U.S. national mortality data are available, 32,163 persons were killed by firearms, equivalent to 88 deaths per day.<sup>13</sup> The annual firearm homicide death toll, at more than 11,000 deaths in 2011, is equivalent to 30 homicides-by-gun per day, a sobering figure that reproduces the Sandy Hook Elementary School body count each day, every day, year-round.<sup>13</sup>

Among the 34 nations characterized as “advanced economies,”<sup>14</sup> the U.S. rates for total firearm deaths (10.3/100,000 in 2011), firearm suicides (6.30/100,000 in 2011), and firearm homicides (3.60/100,000 in 2011), are unmatched.<sup>15-17</sup> In fact, each of these rates is multiple times higher than for any other developed nation.

Firearm mortality in the U.S. represents a compelling public health problem.<sup>18,19</sup> Any comprehensive, population-based approach for reducing the incidence of firearm violence must begin by defining the intricate epidemiologic patterning of firearm-related injury and mortality, including both suicide and homicide by firearms and accidental gun deaths.<sup>6,19</sup>

#### Shooting massacres in school and community settings

North and King (2009) examined trends in shooting massacres.<sup>20</sup> According to these authors, the frequency of mass

shooting events, occurring in school and community settings, has increased with accelerating pace since 1966, beginning with the Austin Tower shootings on the University of Texas campus. Among the top 12 deadliest shootings in history,<sup>21</sup> four were school shootings, including the top two deadliest mass shooting events, Virginia Tech University in 2007 (32 firearm homicides and the shooter, Mr. Cho, committed suicide)<sup>22,23</sup> and Sandy Hook Elementary School in 2012 (26 firearm homicides at the school following the killing of the shooter’s mother at her home, and the shooter, Mr. Lanza, committed suicide).<sup>1</sup> Analyses presented here will examine whether the upward trend noted by North and King continues almost one-half century after the seminal incident in Austin, Texas.

Specific to school shootings, Muschert<sup>24</sup> has devised a five-point typology that includes 1) rampage shootings, 2) school invasion mass murders, 3) terrorist attacks on a school or school children, 4) school-related targeted shootings, and 5) government shootings taking place at schools (e.g. Ohio National Guard shooting of Kent State students, May 4, 1970). Fortunately, in the U.S. there have been no terrorist attacks in schools, although the horrific spectacle of the Beslan School hostage crisis in 2004 compels all nations to be vigilant.<sup>25-29</sup> In that event, Chechen and Ingush separatist militants laid siege to Beslan School Number One, in North Ossetia, an autonomous republic in the Russian Federation, holding 1,100 hostages. When Russian security forces entered the building on the third day, 386 persons were killed (334 were hostages, including 156 children) from a combination of improvised explosives, rockets, artillery, and small weapons fire.

The shooting massacres at Sandy Hook Elementary School,<sup>1,9</sup> Virginia Tech University,<sup>22,23</sup> and Columbine High School<sup>2,30-35</sup> are the three highest-fatality examples of “rampage shootings,” as described by Newman et al.<sup>36</sup> in their book, *Rampage: The Social Roots of School Shootings*, in this manner: “An institutional attack takes place on a public stage before an audience, is committed by a member or former member of the institution, and involves

**Table 1.** Firearm death rates and ranks among developed nations representing the 34 “advanced economies”.

Nations with advanced economies	Firearm homicides (per 100,000)		Firearm suicides (per 100,000)		Total firearm deaths (per 100,000)		Firearm possession (per 100 persons)	
	Rate	Rank	Rate	Rank	Rate	Rank	Rate	Rank
<b>Americas</b>								
United States	3.60	1	6.30	1	<b>10.30</b>	<b>1</b>	101.1	1
Canada	0.50	7	1.79	8	<b>2.38</b>	<b>9</b>	23.8	11
<b>Asia</b>								
Hong Kong	<0.01	32	0.03	34	<b>0.03</b>	<b>34</b>	NA	NA
Japan	<0.01	32	0.04	32	<b>0.06</b>	<b>32</b>	0.6	32
Korea, South	<0.01	32	0.04	32	<b>0.06</b>	<b>32</b>	1.1	31
Singapore	0.02	31	0.12	30	<b>0.16</b>	<b>31</b>	0.5	33
Taiwan Province	0.60	3	0.12	30	<b>0.87</b>	<b>27</b>	4.4	29
<b>Europe</b>								
Austria	0.18	23	2.68	4	<b>2.94</b>	<b>5</b>	30.4	8
Belgium	0.29	15	1.96	7	<b>2.42</b>	<b>8</b>	17.2	14
Cyprus	0.24	18	0.48	26	<b>0.96</b>	<b>26</b>	36.4	4
Czech Republic	0.12	27	1.39	12	<b>1.76</b>	<b>15</b>	16.3	15
Denmark	0.30	13	1.16	15	<b>1.45</b>	<b>20</b>	12.0	19
Estonia	0.30	13	1.57	11	<b>2.54</b>	<b>6</b>	9.2	23
Finland	0.26	16	3.34	2	<b>3.64</b>	<b>3</b>	45.7	2
France	0.22	19	2.33	6	<b>3.01</b>	<b>4</b>	31.2	7
Germany	0.20	20	0.94	20	<b>1.24</b>	<b>23</b>	30.3	9
Greece	0.59	5	0.97	19	<b>1.64</b>	<b>17</b>	22.5	13
Iceland	0.32	12	1.25	13	<b>1.57</b>	<b>18</b>	30.3	9
Ireland	0.36	10	0.56	25	<b>1.03</b>	<b>25</b>	5.6	28
Italy	0.36	10	0.81	22	<b>1.28</b>	<b>22</b>	11.9	20
Luxembourg	0.60	3	1.00	18	<b>2.02</b>	<b>11</b>	15.3	16
Malta	0.48	8	1.68	10	<b>2.16</b>	<b>10</b>	11.9	20
Netherlands	0.20	20	0.24	28	<b>0.46</b>	<b>29</b>	3.9	30
Norway	0.04	29	1.72	9	<b>1.78</b>	<b>13</b>	31.3	6
Portugal	0.48	8	1.09	17	<b>1.77</b>	<b>14</b>	8.5	24
Slovak Republic	0.18	23	0.94	20	<b>1.75</b>	<b>16</b>	8.3	25
Slovenia	0.05	28	2.34	5	<b>2.49</b>	<b>7</b>	13.5	18
Spain	0.15	25	0.42	27	<b>0.62</b>	<b>28</b>	10.4	22
Sweden	0.19	22	1.20	14	<b>1.47</b>	<b>19</b>	31.6	5
Switzerland	0.52	6	3.15	3	<b>3.84</b>	<b>2</b>	45.7	2
United Kingdom	0.04	29	0.18	29	<b>0.25</b>	<b>30</b>	6.7	27
<b>Middle East</b>								
Israel	0.94	2	0.71	24	<b>1.87</b>	<b>12</b>	7.3	26
<b>Oceania</b>								
Australia	0.13	26	0.73	23	<b>1.06</b>	<b>24</b>	15.0	17
New Zealand	0.26	16	1.14	16	<b>1.45</b>	<b>20</b>	22.6	12

**Table 2.** Annual firearm mortality by type of death, 1990-2011.

Year	Annual firearm mortality by year, 1990-2011			
	Firearm homicides	Firearm suicides	Other firearm deaths	Total firearm deaths
1990	16,218	18,885	2,052	<b>37,155</b>
1991	17,746	18,526	2,045	<b>38,317</b>
1992	17,488	18,169	2,119	<b>37,776</b>
1993	18,253	18,940	2,402	<b>39,595</b>
1994	17,527	18,765	2,213	<b>38,505</b>
1995	15,551	18,503	1,903	<b>35,957</b>
1996	14,037	18,166	1,837	<b>34,040</b>
1997	13,252	17,566	1,618	<b>32,436</b>
1998	11,798	17,424	1,486	<b>30,708</b>
1999	10,828	16,599	1,447	<b>28,874</b>
2000	10,801	16,586	1,276	<b>28,663</b>
2001	11,348	16,869	1,356	<b>29,573</b>
2002	11,829	17,108	1,305	<b>30,242</b>
2003	11,920	16,907	1,309	<b>30,136</b>
2004	11,624	16,750	1,195	<b>29,569</b>
2005	12,352	17,002	1,340	<b>30,694</b>
2006	12,791	16,883	1,222	<b>30,896</b>
2007	12,632	17,352	1,240	<b>31,224</b>
2008	12,179	18,223	1,191	<b>31,593</b>
2009	11,493	18,735	1,119	<b>31,347</b>
2010	11,078	19,392	1,202	<b>31,672</b>
2011	11,101	19,766	1,296	<b>32,163</b>
<b>Total</b>	<b>293,846</b>	<b>393,116</b>	<b>34,173</b>	<b>721,135</b>

multiple victims, some chosen for their symbolic significance or at random. This final condition signifies that it is the organization, not the individuals, who are important.” Actually, the episode at Sandy Hook Elementary School represents the cusp between rampage shootings (Mr. Lanza was a former student, ostensibly an “insider”) and a school-related mass murder (at age 20, Mr. Lanza had graduated from Sandy Hook more than a decade earlier and was, in a sense, an “outsider”).<sup>24</sup> Analyses reported here will classify school shootings into the categories of random/rampage (a combination of rampage and school-based mass murder categories in the Muschert typology<sup>24</sup>), targeted, and other, in keeping with previous studies from another of our authors (RF).<sup>37</sup>

To place school-based shooting incidents in public health context, a “top-down” sequence of analyses is presented: 1) international data and rankings of firearm deaths, homicides, and suicides for the world’s 34 “advanced economies;” 2) numbers and time trends in U.S. firearm deaths, homicides, and suicides; 3) 12 deadliest mass shootings and 12 deadliest school shootings in U.S. history; 4) annual school shooting incidents and fatalities; 5) single- vs. multiple-victim school shootings; 6) numbers and trends in school shootings categorized into random/rampage, targeted, or other shooting incidents; and 7) analyses of distinctions between random and targeted shootings in terms of type of

school, urban – rural continuum, and perpetrator characteristics. Starting broadly by examining global patterns of firearm deaths, the focus is successively narrowed to U.S. firearm mortality in recent decades, then to firearm homicides, school-based fatal shooting incidents, and finally, to random and targeted subcategories of school shootings.

## Methods

A top-down examination of U.S. firearm deaths was performed in the seven-step sequence described below.

### 1) International rankings of firearm fatalities

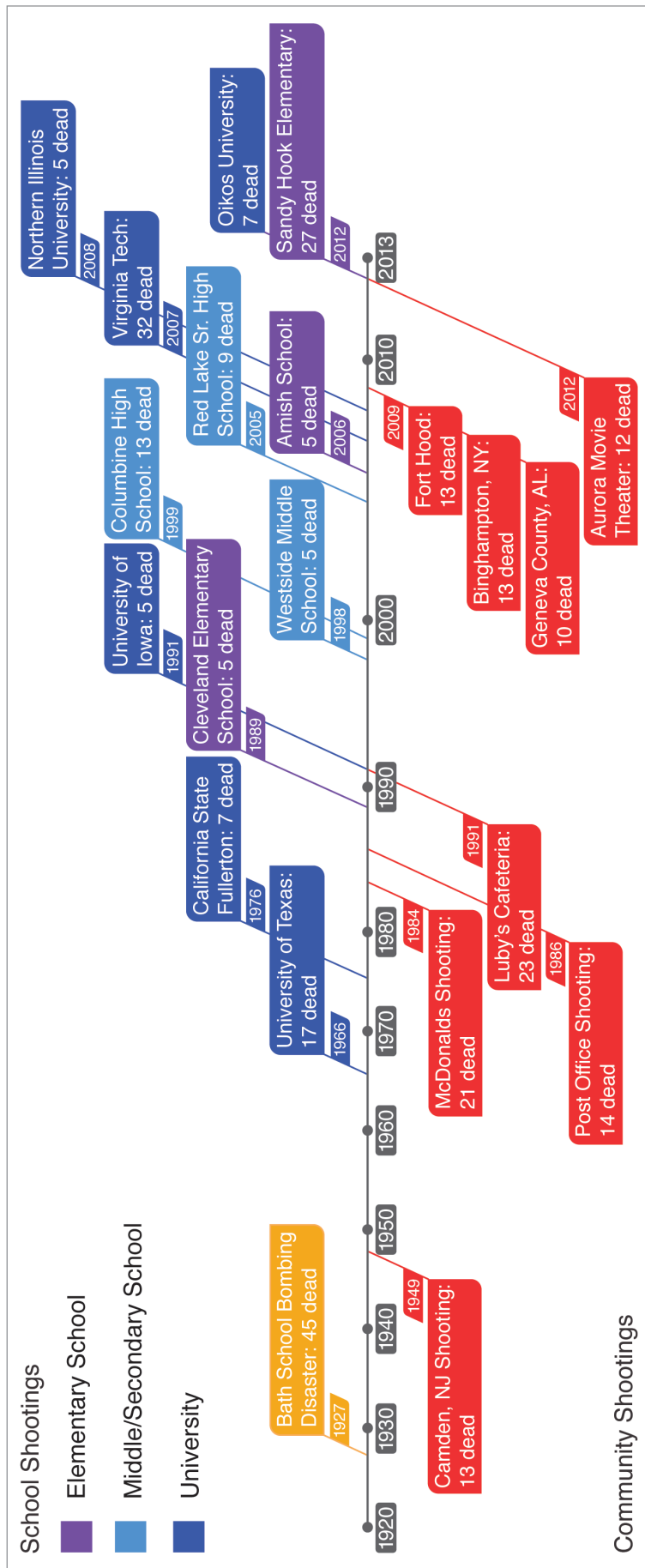
Rates of total U.S. firearm deaths, firearm homicides, and firearm suicides per 100,000 citizens, and gun ownership per 100 citizens, were compared to rates among the remainder of the 34 nations with “advanced economies” as identified by the International Monetary Fund (IMF).<sup>14-16</sup> The original source for rate and rankings data was a series of country-level reports compiled by the University of Sydney School of Public Health.<sup>15</sup> Rate and rank data were organized for the 34 nations, grouped by continent or region, and listed alphabetically within regional groups (Table 1).

### 2) U.S. national firearm mortality data

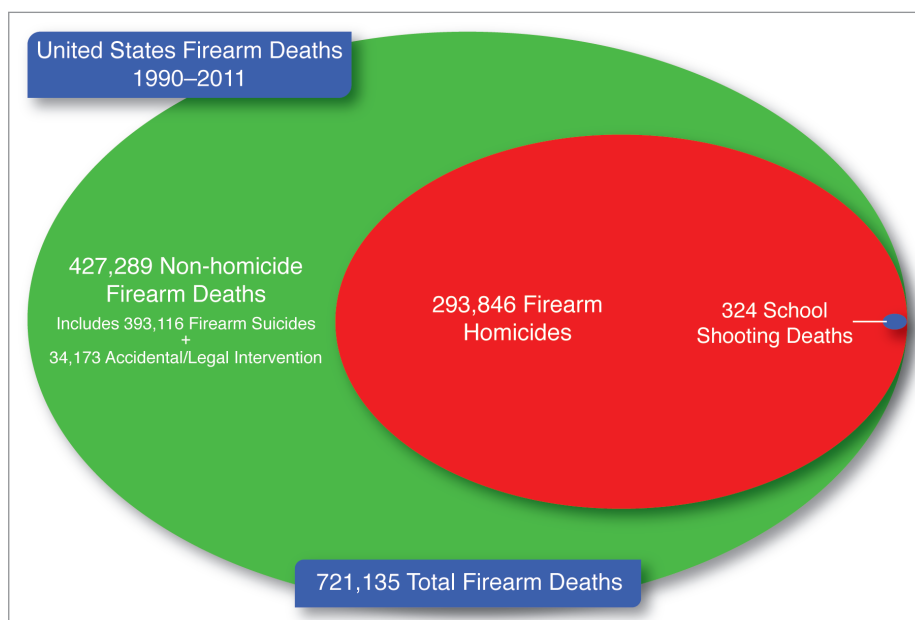
Firearm mortality data for the 22 years, 1990-2011, were obtained from a series of annual National Vital Statistics Reports developed by the National Center for Health Statistics (NCHS).<sup>13,38-50</sup> “Final” death data were available for all years, 1990-2010,<sup>38-50</sup> and “preliminary” death data were available for 2011.<sup>13</sup> NCHS does not yet have mortality data compiled for 2012, the year of the Sandy Hook Elementary School shooting. NCHS data categorizes firearm deaths into firearm suicides, firearm homicides, accidental discharge of a firearm, deaths from firearms occurring during “legal intervention,” and a small residual category described as firearm “deaths of undetermined intent.” Data from these vital statistics reports were compiled by year into tabular format with separate columns for total firearm deaths, firearm homicides, firearm suicides, and “other” firearm deaths [calculated as (total deaths) – (homicides) – (suicides)] (Table 2). Each of the annual vital statistics reports provided population (denominator) estimates from the U.S. census used in the computation of firearm death rates per 100,000 U.S. citizens. From these reports, annual rates for total firearm deaths, firearm homicides, firearm suicides, and other firearm deaths were obtained and presented graphically to display time trends (Fig. 1).

### 3) U.S. mass shooting events

The scholarly literature on mass shooting events was explored,<sup>2,36,51</sup> and lists of the deadliest mass shootings and school shootings were examined.<sup>21,52,53</sup> The 12 deadliest U.S. mass shootings and 12 deadliest U.S. school shootings were tabulated in order by numbers of deaths and described in terms of event, date, city, state, setting, and numbers of persons killed and injured (Tables 3 and 4).<sup>21,52,53</sup> The top four deadliest school shootings also appeared among the 12 deadliest mass shootings. These high-fatality mass shooting events were portrayed graphically on a timeline, separating school shootings (appearing above the timeline) from non-school “community” shootings



**Figure 2.** Timeline of the deadliest mass shootings in school and community settings, United States.



**Figure 3.** Firearm deaths in the United States, 1990–2011.

**Table 3.** 12 deadliest mass shooting events in the United States.

Rank	Event	City/State	Setting	Date	Killed	Injured
1	<b>Virginia Tech University</b>	Blacksburg, VA	School: University	4/16/2007	32	17
2	<b>Sandy Hook Elementary School</b>	Newtown, CT	School: Elementary	12/14/2012	27	2
3	<b>Luby's Cafeteria</b>	Killeen, TX	Restaurant	8/16/1991	23	20
4	<b>McDonald's Restaurant Shooting</b>	San Ysidro, CA	Restaurant	7/18/1984	21	19
5	<b>University of Texas</b>	Austin, TX	School: University	8/1/1966	17	31
6	<b>Post Office Shooting</b>	Edmond, OK	Post Office	8/20/1986	14	6
7-10	<b>Columbine High School</b>	Littleton, CO	School: Secondary	4/20/1999	13	21
7-10	<b>Immigration Services Center</b>	Binghamton, NY	Government Office	4/3/2009	13	4
7-10	<b>Fort Hood Shooting</b>	Fort Hood, TX	Military Base	11/5/2009	13	32
7-10	<b>Camden Shooting</b>	Camden, NJ	Downtown Camden	9/6/1949	13	3
11	<b>Aurora Movie Theater</b>	Aurora, CO	Movie Theatre	7/20/2012	12	58
12	<b>Geneva County Shooting</b>	Geneva County, AL	Alabama Towns	3/10/2009	10	6
<b>Totals</b>					<b>208</b>	<b>219</b>

(appearing below the timeline) (Fig. 2). For the purposes of this epidemiological analysis, Tables 3 and 4 provide tallies of the deaths among shooting victims but exclude deaths of shooters. One of our authors (GWM) has carefully examined the issue of including versus excluding shooters and has published on this theme from a sociological vantage.<sup>54,55</sup>

#### 4) School shooting incidents and fatalities

School shootings were tallied and categorized (Table 5) for the period 1990 through 2012, by reviewing several corroborating sources. Mortality from school shootings was examined in relation to total firearm deaths, suicides, and homicides (Table 6, Fig. 3).

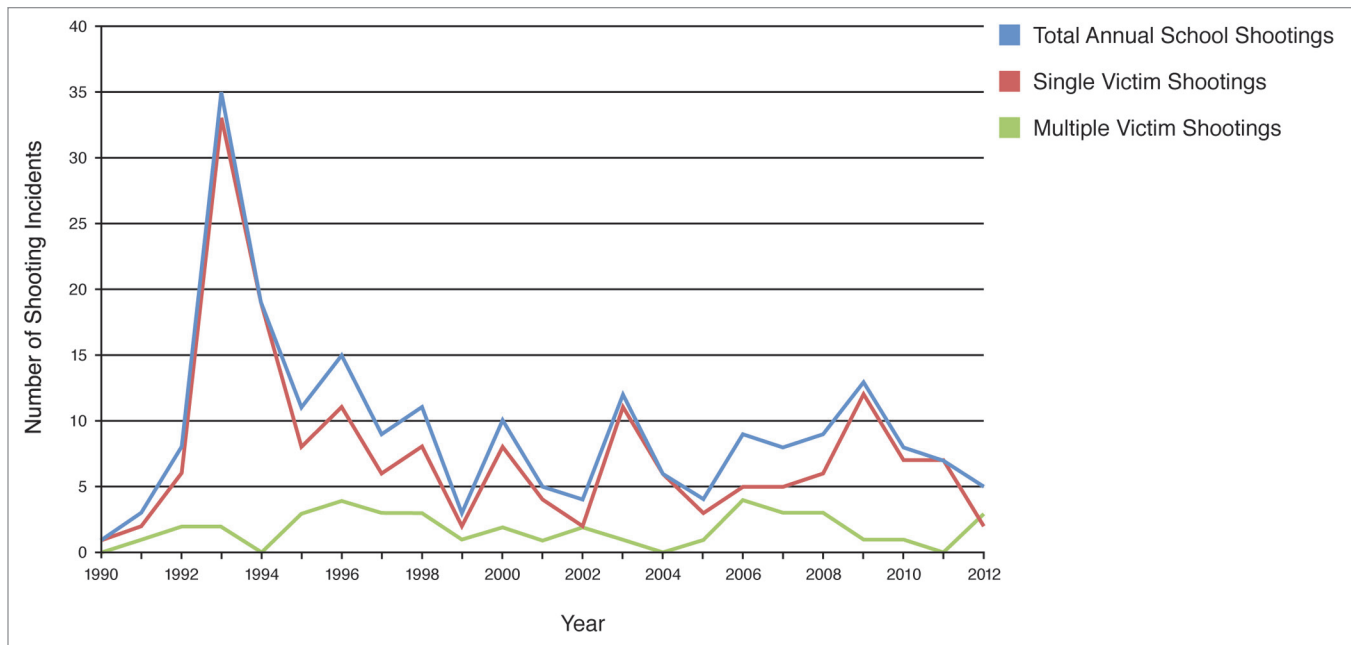
##### Primary sources

Appendix L of the Virginia Tech Review Panel details fatal school shootings of 1966 – 2007, giving the date, location, and

a brief description of the incident.<sup>56</sup> Slate Magazine has compiled a list of fatal school shootings from 1980 to 2012, providing the date, location, number killed, and a timeline graphic of these incidents.<sup>57</sup> The National School Safety Center published a report on all school associated deaths, including suicides, homicides, and accidental deaths from 1992 to 2010, giving the date, school name, location, victims' names, method of killing (e.g. shooting, stabbing, etc.), reason for killing (e.g. gang-related, suicide, accident, etc.), number of victims, and a description of the incident.<sup>58</sup> The Brady Campaign to Prevent Gun Violence also produced a listing of school shooting events for the period, 1997 through 2012, giving the date, location, and a brief description of each event.<sup>59</sup>

School shooting incidents for the period 1990 through 2012 were included in the present analysis if they were listed in rosters





**Figure 4.** United States school shootings: Single victim vs. multiple victim shooting incidents, 1990–2012.

of school shootings provided by either the Virginia Tech Review Panel Appendix L<sup>56</sup> or the Slate Magazine analysis.<sup>57</sup>

The National School Safety Center’s list<sup>58</sup> was detailed and more expansive, listing many incidents that were suicides or homicides only indirectly related to the school. Thus, only incidents meeting specific criteria were selected from this list for inclusion in the present study. To be included in the roster of school shootings, an incident from the National School Safety Center’s list needed to indicate the method of death as shooting (deaths from stab/slashing, hanging, jumping, and unknown methods were excluded). Firearm deaths in school settings that were categorized as suicide or legal intervention were excluded, but the remaining categories (interpersonal dispute, gang-related, robbery, accidental, and unknown) were included. To be included in the analysis, location had to be listed as: on campus, playground, hallway, school parking lot, bus/bus stop, athletic field/gym, or school classroom/office. The only location descriptor that was excluded was “near school.” Fatal school firearm incidents from the Brady Campaign to Prevent Gun Violence list<sup>59</sup> were used if the incident could be corroborated with a published news article.

During 21 years, 1990–2010, for which estimates of student enrollment (elementary, middle school, high school, and college/university) were available to use as denominator data,<sup>60,61</sup> it was possible to calculate school shooting death rates.

##### 5) Single vs. multiple victim school shootings

In parallel with previous reviews of school shootings,<sup>62</sup> the roster of selected/included episodes was classified in terms of single victim vs. multiple victim incidents and presented as a graph (Fig. 4).

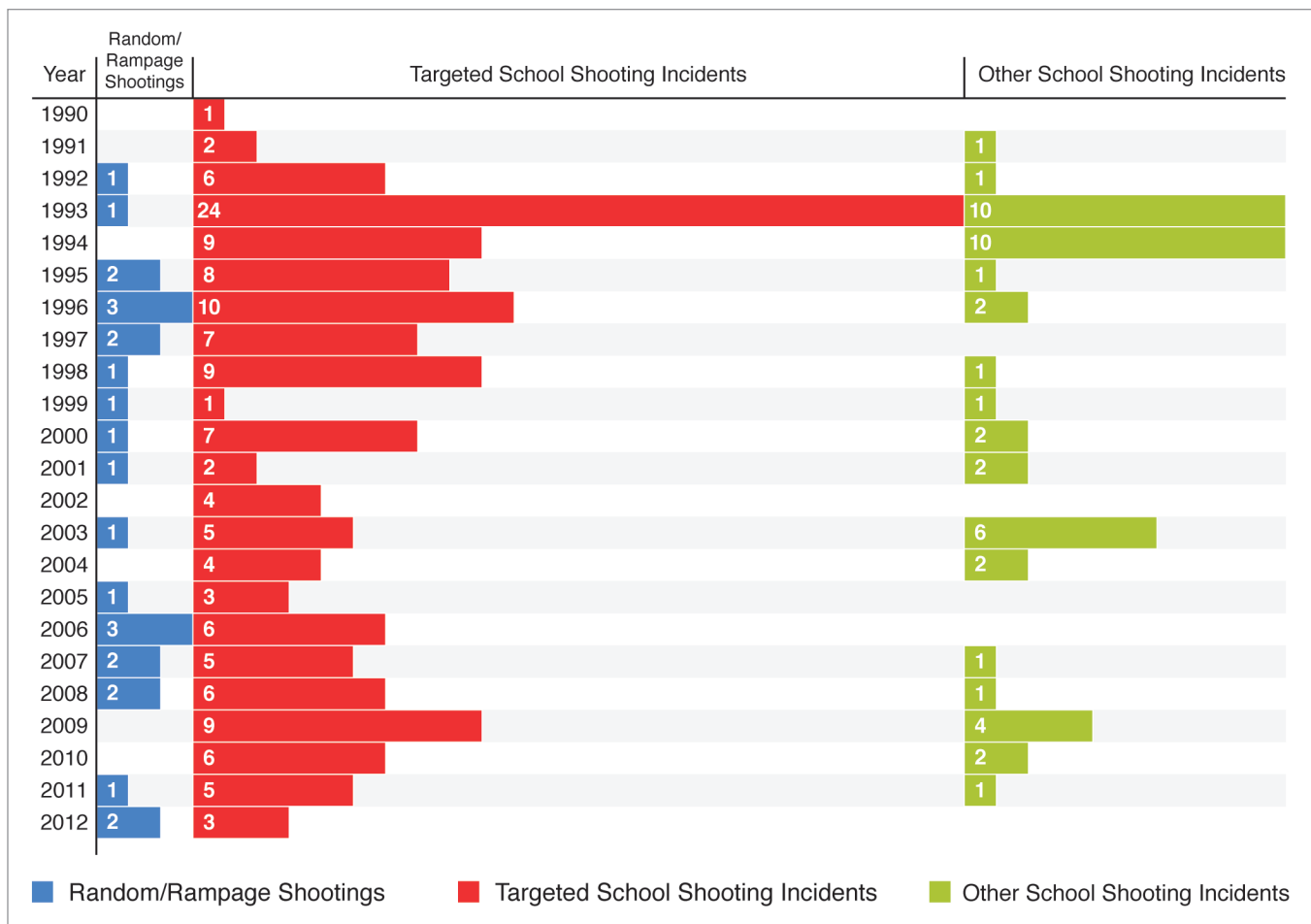
##### 6) Numbers and trends in fatal school shootings categorized into random/rampage, targeted, or other shooting incident

Details on each of the enumerated fatal school shooting events were compared among the four primary sources<sup>56–59</sup>

and supplemented with news articles gathered by searching the name of the school, the year of the shooting, and the word “shooting” to classify each incident as random, targeted or other (Tables 5 and 6, Figs. 3, 5, 6 and 7). A shooting was classified as a “random/rampage” incident if it involved 1) a perpetrator, 2) the intention to commit homicide, 3) no specific person identified as the targeted victim, and 4) one or more victim fatalities. This category subsumes both rampage shootings and school invasion mass murders from the Muschert typology.<sup>24</sup> Two shootings were classified as random even though some of the victims were targeted because the part of the incident that occurred on a school campus was random, even though targeted victims (family members in both instances) were killed off campus. A “targeted” incident was one that involved 1) a perpetrator, 2) the intention to shoot someone, 3) a specific targeted person, and 4) death or injury of the targeted person. Gang violence that involved the death of the intended target as the victim was classified as targeted. Incidents were classified as targeted when others, in addition to the targeted individual, were killed. Shootings committed during robbery were also classified as targeted, even if there was no pre-meditated intention to kill the victim. Shooting incidents were classified as “other” if they were accidental, missed the intended target, involved the shooting death of bystanders (but not the intended target) during gang violence, occurred as an act of self-defense, or when it was impossible to determine whether the incident was random or targeted.

##### 7) Comparison of targeted versus random school shootings

Using geo-coded data for the site of the school shootings, two maps were developed to display and contrast the number and geographic distribution of the random/rampage and targeted shootings (Fig. 7). By using different colors/shapes for the location markers, the shooting incidents were simultaneously portrayed



**Figure 5.** Fatal random/rampage, targeted, and other school shooting incidents by year, United States, 1990–2012.

along a four-category, urban–rural continuum consisting of urban/inner city, suburban, town, and rural locales (Fig. 7).

Data analyses contrasted random, targeted, and other school shootings in terms of type of school (elementary school, middle school, high school, college/university) (Table 7), urban-rural continuum (urban/inner city, suburban, town, rural) (Table 8), and perpetrator characteristics (Table 9). Perpetrator information was gathered when available, linked to the year of incident, school name, and school location (city and state). Information from the four primary sources<sup>56-59</sup> that provided lists of school shootings was compiled on the perpetrator(s) including the perpetrator’s age, gender, relation to the school setting where the incident occurred, and whether the perpetrator committed suicide.

## Results

### 1) International rankings of firearm fatalities

The U.S. ranks first among the 34 nations with IMF-defined “advanced economies”<sup>14</sup> in rates of total firearm deaths, firearm homicides, and firearm suicides per 100,000 persons and gun ownership per 100 citizens (Table 1).<sup>15-17</sup> However, it should be noted that about one dozen developing nations, primarily in Latin America, have higher rates of total firearm deaths (Top 5:

Honduras, El Salvador, Swaziland, Guatemala, Colombia) and firearm homicides (Top 5: Honduras, El Salvador, Jamaica, Swaziland, Guatemala) compared to the U.S.<sup>15,16</sup>

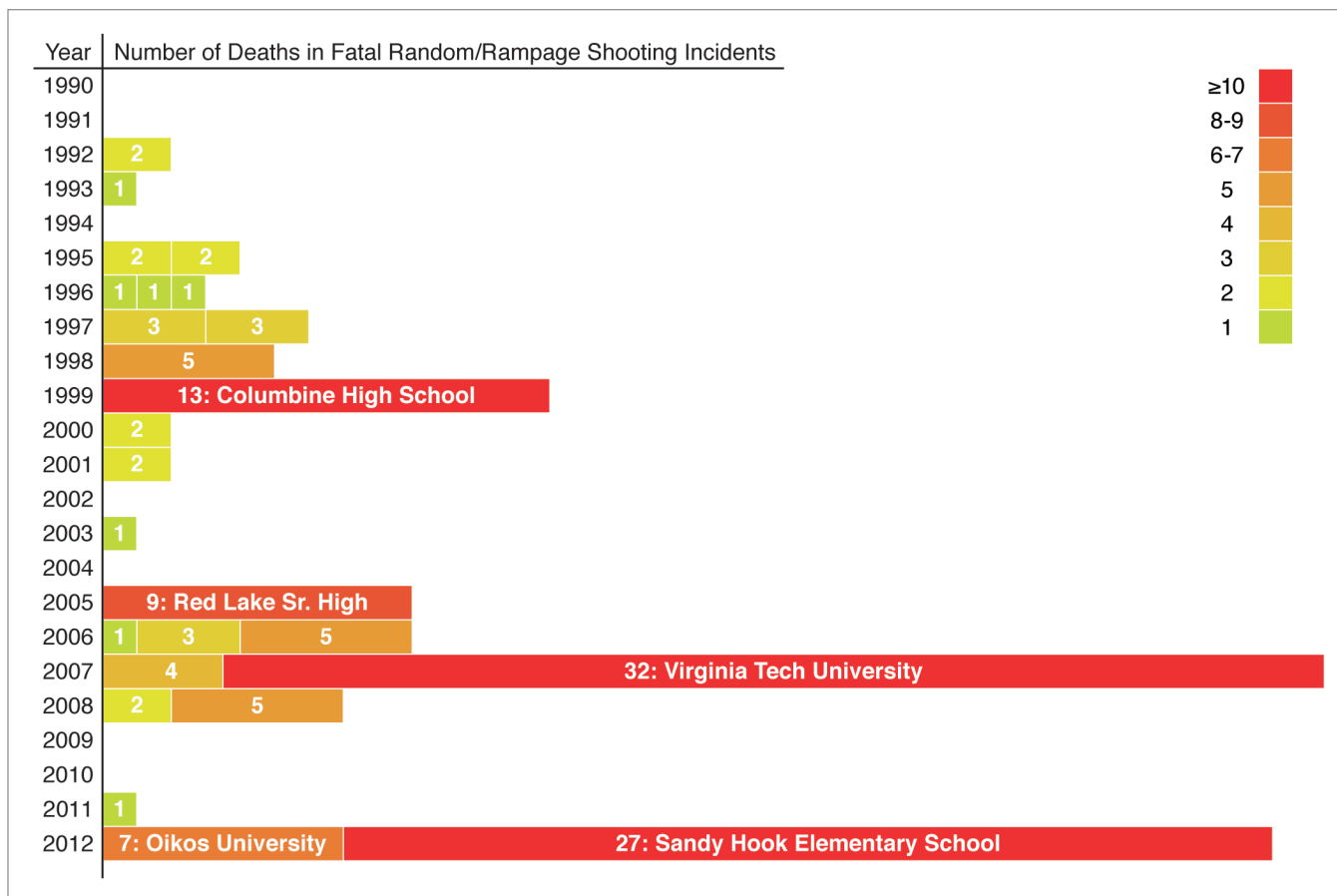
### 2) U.S. national firearm mortality data, 1990-2011

Annual U.S. firearm deaths for the 22 years, 1990-2011, were categorized into firearm homicides, firearm suicides, other firearm deaths, and total firearm deaths (Table 2). Converted to annual rates per 100,000 U.S. citizens, these data were compiled for each of these categories of firearm deaths and presented graphically to examine trends (Fig. 1). The decline in firearm homicides was the major contributor to a corresponding decline in total firearm deaths. In the early 1990s, firearm homicides declined by about one-third from around 17,000 firearm homicides per year to approximately 11-12,000 per year. In parallel, total firearm deaths dropped from 37-38,000 per year to 31-32,000 per year, with corresponding rates dropping from the range of 15 firearm deaths per 100,000 citizens to about 10/100,000. Firearm suicide death rates displayed a downward trend during the late 1990s and early 2000s but this was reversed by a notable upturn since 2006, with increasing numbers and rates each year through 2011.

#### *Firearm fatalities in the United States, 2011*

In 2011, 32,163 persons died in firearm-related incidents (Table 2).<sup>13</sup> Firearms were used in 19,766 (51.6%) of 38,285





**Figure 6.** Number of deaths in fatal random/rampage school shootings by incident and year, United States, 1990–2012.

suicides (episodes of “intentional self-harm”) and 11,101 (69.6%) of 15,953 homicides. There were also 851 accidental deaths due to discharge of a firearm, 222 firearm deaths of undetermined intent, and 223 firearm deaths due to “legal intervention.”

*Twenty-two years of firearm fatalities in the United States, 1990-2011*

During the 22-year period, 1990-2011, for which U.S. national mortality figures are available, 721,135 firearm deaths occurred, equivalent to an average of 32,779 deaths annually. Among these, more than half were firearm suicides (393,116, 54.5%). Ongoing increases in suicides have occurred among the civilian population, particularly in the age group 35-64 years.<sup>63,64</sup> Rates of suicides in both active-duty military personnel and armed forces veterans have prompted epidemiologic studies and intervention research.<sup>65-67</sup> In all population subsets, firearms represent the most common “lethal means” by which individuals commit, and “complete,” an act of suicide.<sup>66</sup> Although suicide deaths are not the primary focus of this analysis, the fact that firearms are the primary method of inflicting “intentional self-harm” resulting in death adds a relevant dimension to this discussion.

Returning to the 22-year period, 1990-2011, 293,846 firearm homicides accounted for 40.8 percent of total firearm deaths. Thus, over more than two decades, the average annual number of homicides was 13,356 (almost 37 per day). Fortunately, in contrast to the rise in suicide rates in recent years, the rates and the

absolute numbers of both total homicides and firearm homicides have significantly declined during this period.<sup>64</sup> Furthermore, the percentage of homicides committed using firearms has significantly decreased.

**3) U.S. mass shooting events**

The 12 deadliest mass shooting events in U.S. history, through year-end 2012, have all occurred since 1949, claiming a total of 208 lives. Six of these episodes, accounting for 107 deaths, have taken place since 2007. In parallel, the 12 deadliest school massacres in U.S. history have occurred since 1966, claiming a total of 137 lives. Six of these episodes, accounting for 85 deaths, have occurred since 2005. As displayed in Tables 3 and 4, and Figure 2, there is an overlap; among the 12 deadliest mass shooting events, four have occurred in school settings (rank order: 1, 2, 5, and 7). Not included in this analysis, but displayed in Figure 2, is the deadliest school-based mass murder, the 1927 bombing of a school in Bath, Michigan that killed 38 elementary students and 6 adults. This was not a firearm incident although the bomber used a gun to kill his wife prior to blowing up the school.<sup>68</sup>

**4) School shooting incidents and fatalities: Twenty-three years of school shootings in the United States, 1990-2012**

Perpetrated school shootings represent a distinct subset of firearm homicides. Over the 23-year period, 1990-2012, a total of 215 fatal school shooting incidents occurred (9.3 per year;

**Table 4.** 12 deadliest school shooting events in the United States.

Rank	Event	City/State	Setting	Date	Killed <sup>1</sup>	Injured <sup>2</sup>
1	<b>Virginia Tech University</b>	Blacksburg VA	School: University	4/16/2007	<b>32</b> 27 students, 5 professors	<b>17 + 9</b> 17 students shot, 6 students injured while escaping, 3 students injured: other causes
2	<b>Sandy Hook Elementary School</b>	Newtown CT	School: Elementary	12/14/2012	<b>26 + 1</b> 20 students, 2 teachers, 2 teacher's aides, principal, school psychologist + shooter's mother (at home)	<b>2</b> 2 teachers
3	<b>University of Texas Tower Shooting</b>	Austin TX	School: University	8/1/1966	<b>15 + 2</b> 1 school employee, 1 professor, 1 police officer, 4 students, 1 unborn baby, 1 university visitor, 6 town residents, + shooter's mother and wife (off-campus)	<b>31</b> Variety of pedestrians shot by sniper fire
4	<b>Columbine High School</b>	Littleton CO	School: Secondary	4/20/1999	<b>13</b> 12 students, 1 teacher	<b>21 + 3</b> 21 students shot, 3 injured while escaping
5	<b>Red Lake Senior High</b>	Red Lake MN	School: Secondary	3/5/2005	<b>7 + 2</b> 5 students, 1 teacher, 1 security guard, + shooter's grandfather & grandfather's girlfriend (off-site)	<b>7</b> 7 students shot
6/7	<b>Oikos University Shooting</b>	Oakland CA	School: University	4/2/2012	<b>7</b> 6 students, 1 employee	<b>3</b> 3 people shot
6/7	<b>California State at Fullerton</b>	Fullerton CA	School: University	7/12/1976	<b>7</b> 1 professor, 6 school employees	<b>2</b> 2 co-workers
8-12	<b>Cleveland School Massacre</b>	Stockton CA	School: Elementary	1/17/1989	<b>5</b> 5 students	<b>30</b> 29 students, 1 teacher
8-12	<b>Northern Illinois University</b>	Dekalb IL	School: University	2/14/2008	<b>5</b> 5 students	<b>17 + 4</b> 17 students shot, 3 students injured while escaping, 1 student injured: other causes
8-12	<b>Westside Middle School Shooting</b>	Jonesboro AR	School: Secondary	5/25/1998	<b>5</b> 4 students, 1 teacher	<b>10</b> 9 students, 1 teacher
8-12	<b>Amish School Shooting</b>	Nickel Pines PA	School: Elementary	10/2/2006	<b>5</b> 5 female students	<b>5</b> 5 female students
8-12	<b>University of Iowa Shooting</b>	Iowa City IA	School: University	1/1/1991	<b>5</b> 1 student, 3 professors, 1 administrator	<b>1</b> 1 student
<b>Totals</b>					<b>132 + 5</b>	<b>146 + 16</b>

<sup>1</sup>Deaths on school premises + other deaths; <sup>2</sup>Firearm injuries + non-firearm injuries

range: 1-35) resulting in 363 deaths (15.8 per year; range: 1-44) (Table 5). The mean number of fatalities per school shooting across these 215 incidents was 1.69 deaths and most school shootings resulted in a single death.

For 1990-2012, among the 215 episodes of fatal school shootings, only nine resulted in five or more deaths (32, 27, 13, 9, 7, 5, 5, 5, 5 deaths, respectively). These nine are all represented among the 12 deadliest school shootings in U.S. history (Table 2, Fig. 2). The other three school shootings with five or more deaths (17, 7, 5 deaths, respectively) occurred prior to 1990. It is instructive, therefore, to note the extreme rarity of school "shooting massacres" in the context of the large numbers of firearm deaths and homicides.

During 21 years, 1990-2010, for which an estimate of student enrollment (elementary, middle school, high school, and college/university) exists, it is possible to calculate school shooting death rates. During that period, the number of school shooting deaths per year ranged from 1 (in 1990) to 44 (in 2007) and the total student enrollment for all grades, including institutions of higher education, increased every year, from 61 million (1990) to 76 million (2010). During this time period the school firearm death rate ranged from 0.16 deaths per 10 million students (1990) to 6.1 deaths per 10 million students (2007).

When examining school shooting deaths in relation to the overarching patterns of firearm deaths, the comparison is restricted to

**Table 5.** Number of fatal school shooting incidents and deaths by type of shooting, 1990-2012.

Year	Number of fatal school shooting incidents by type and year, 1990-2012				Number of fatal school shooting deaths by shooting type and year, 1990-2012			
	Random/rampage shootings	Targeted shootings	Other	Total	Random/rampage shootings	Targeted shootings	Other	Total
1990	0	1	0	1	0	1	0	1
1991	0	2	1	3	0	6	1	7
1992	1	6	1	8	2	9	1	12
1993	1	24	10	35	1	25	11	37
1994	0	9	10	19	0	9	10	19
1995	2	8	1	11	4	9	1	14
1996	3	10	2	15	3	16	2	21
1997	2	7	0	9	6	8	0	14
1998	1	9	1	11	5	14	1	20
1999	1	1	1	3	13	1	1	15
2000	1	7	2	10	2	8	2	12
2001	1	2	2	5	2	2	2	6
2002	0	4	0	4	0	8	0	8
2003	1	5	6	12	1	6	6	13
2004	0	4	2	6	0	4	2	6
2005	1	3	0	4	9	3	0	12
2006	3	6	0	9	9	8	0	17
2007	2	5	1	8	36	7	1	44
2008	2	6	1	9	7	7	1	15
2009	0	9	4	13	0	10	4	14
2010	0	6	2	8	0	8	2	10
2011	1	5	1	7	1	5	1	7
2012	2	3	0	5	34	5	0	39
<b>Total</b>	<b>25</b>	<b>142</b>	<b>48</b>	<b>215</b>	<b>135</b>	<b>179</b>	<b>49</b>	<b>363</b>

the 22-year period, 1990-2011, because U.S. national mortality figures are not available for 2012. It is notable that during this 22-year interval, the 324 school shooting deaths were equivalent to 0.11% of the 293,846 firearm homicides and 0.04% of the 721,135 total firearm deaths (Table 6, Fig. 3).

**5) Single vs. multiple victim school shootings, 1990-2012**

As a parallel portrayal of the point just made, a spike in single-victim school shootings occurred in 1993 and 1994 but annual numbers of single-victim incidents have remained stable in the 2-to-12 events per year range thereafter. Meanwhile, multiple-victim shooting incidents have fluctuated between 0 and 4 episodes annually for the entire 23-year time period.

**6) Numbers and trends in school shootings categorized into random/rampage, targeted, or other shooting incidents**

For the 23-year period, 1990-2012, the 215 fatal school shooting incidents, resulting in 363 deaths, were distributed as follows: 25 random/rampage shootings (135 deaths), 142 targeted shootings (179 deaths), and 48 other shootings (49 deaths) (Table 5). Targeted – and “other” - school shooting incidents and deaths were elevated for several years in the early 1990s and then diminished, remaining relatively stable during the past 15 years. The

annual number of random/rampage shooting incidents has varied from 0 to 3 events per year without change (Fig. 5).

*Random/rampage school shootings*

For the 23-year analysis (1990-2012), 25 school-based random shooting incidents occurred that resulted in loss of life (135 deaths, mean: 5.40 deaths per incident). The number of random/rampage shooting episodes per year was distributed as follows: 0 incidents (7 years), 1 incident (9 years), 2 incidents (5 years), and 3 incidents (2 years) (Table 5, Fig. 5). Across the 25 incidents, the distribution of random/rampage shooting deaths, in descending order was 32 deaths (1 incident: Virginia Tech University), 27 deaths (1 incident: Sandy Hook Elementary School), 13 deaths (1 incident: Columbine High School), 9 deaths (1 incident: Red Lake Senior High School), 7 deaths (1 incident: Oikos University), 5 deaths (3 incidents: Cleveland School, Northern Illinois University, Amish School), 4 deaths (1 incident), 3 deaths (3 incidents), 2 deaths (6 incidents), and 1 death (7 incidents). As depicted graphically in Figure 6, three of the 25 random shootings—Sandy Hook Elementary School, Columbine High School, and Virginia Tech University—accounted for 72 of the 135 deaths (53.3%).

**Table 6.** Distribution of United States firearm deaths, 1990-2011.

<b>Total Firearm Deaths</b>	<b>721,135</b>	<b>Distribution of 721,135 Firearm Deaths</b>	
<b>Firearm Suicides</b>	<b>393,116 (54.5%)</b>		
<b>Firearm Deaths: Accidental/Other</b>	<b>34,173 (04.7%)</b>		
<b>Firearm Homicides</b>	<b>293,846 (40.8%)</b>	<b>Distribution of 293,846 Firearm Homicides</b>	
<b>Firearm Homicides in Non-School Settings</b>	<b>293,522 (99.89%)</b>		
<b>School Shooting Deaths</b>	<b>324 (00.11%)</b>	<b>Distribution of 324 School Shooting Deaths</b>	
		<b>Targeted School Shooting Deaths</b>	<b>174 (53.7%)</b>
		<b>Other/Unclassified School Shooting Deaths</b>	<b>49 (15.1%)</b>
		<b>Random/Rampage School Shooting Deaths</b>	<b>101 (31.2%)</b>

*Targeted school shootings*

For the 23-year analysis period (1990-2012), 142 fatal school-based targeted shootings occurred, resulting in 179 deaths (mean: 1.26 deaths per incident) (Table 5, Fig. 5). Without exception, targeted shootings occurred every year, ranging from 1 to 24 fatal episodes per year. No targeted shooting resulted in more than 5 deaths, and most incidents resulted in a single shooting fatality. The distribution of targeted shooting deaths in descending order was: 5 deaths (2 incidents: Westside Middle School, University of Iowa), 4 deaths (1 incident), 3 deaths (7 incidents), 2 deaths (12 incidents), and 1 death (120 incidents).

**7) Comparison of targeted versus random school shootings**

During the 23-years, 1990-2012, the 25 random/rampage shootings represented 11.6% of the 215 fatal school shootings and accounted for 135 (37.2%) of the 363 deaths (Table 5). The 142 targeted shootings represented 66.1% of school shootings and accounted for 49.3% of school shooting deaths. The 48 “other shootings” contributed the remaining 22.3% of incidents and 13.5% of school shooting deaths. For comparison of numbers and distribution of random and targeted school shooting events, the incidents were plotted geographically on two comparison U.S. maps (Fig. 7).

*Level of educational institution*

This sub-analysis of 207 school shootings classified the level of the educational institution into four categories: elementary school, middle school, high school, and college/university. About 60% of all school shootings occurred in a high school setting (Table 7).

*Urban-rural continuum*

Schools were classified along an urban-rural gradient as: urban inner city, suburban, small town, or rural. Compared to targeted and other shootings, random shootings tended to occur in either suburban or rural school settings rather than urban inner city locales (Table 8). Figure 7 portrays the urban-rural continuum in two comparison maps of targeted and random shootings.

*Rampage shooter characteristics*

The 12 deadliest school shooting incidents (Table 4, Fig. 2) included 10 random/rampage shootings and two targeted shootings (Westside Middle School, University of Iowa). Among the 14 perpetrators of the 12 deadliest school shootings (Table 4), including two shooters each at Columbine High School and

Westside Middle School, all were male, ages 11-43 (3 juveniles, 8 in the age range 18-28, 3 over 30), 12 were students (8 current and 4 former) at the school where the shooting took place, and nine shooters committed suicide at the scene. In the U.S., rates of firearm homicides are highest in African-Americans (the majority of both shooters and victims are African-American). Yet none of these 14 shooters (12 white/non-Hispanic, 1 Asian, 1 American Indian) and few of the victims were African-American. Perpetrators of school massacres, and their victims, appear to diverge from the prevalent demographic patterns of the remainder of firearm homicides. On some occasions, the perpetrator has demonstrated behavior problems and is not “fitting in,” a problem that is exacerbated in school systems in close-knit communities.

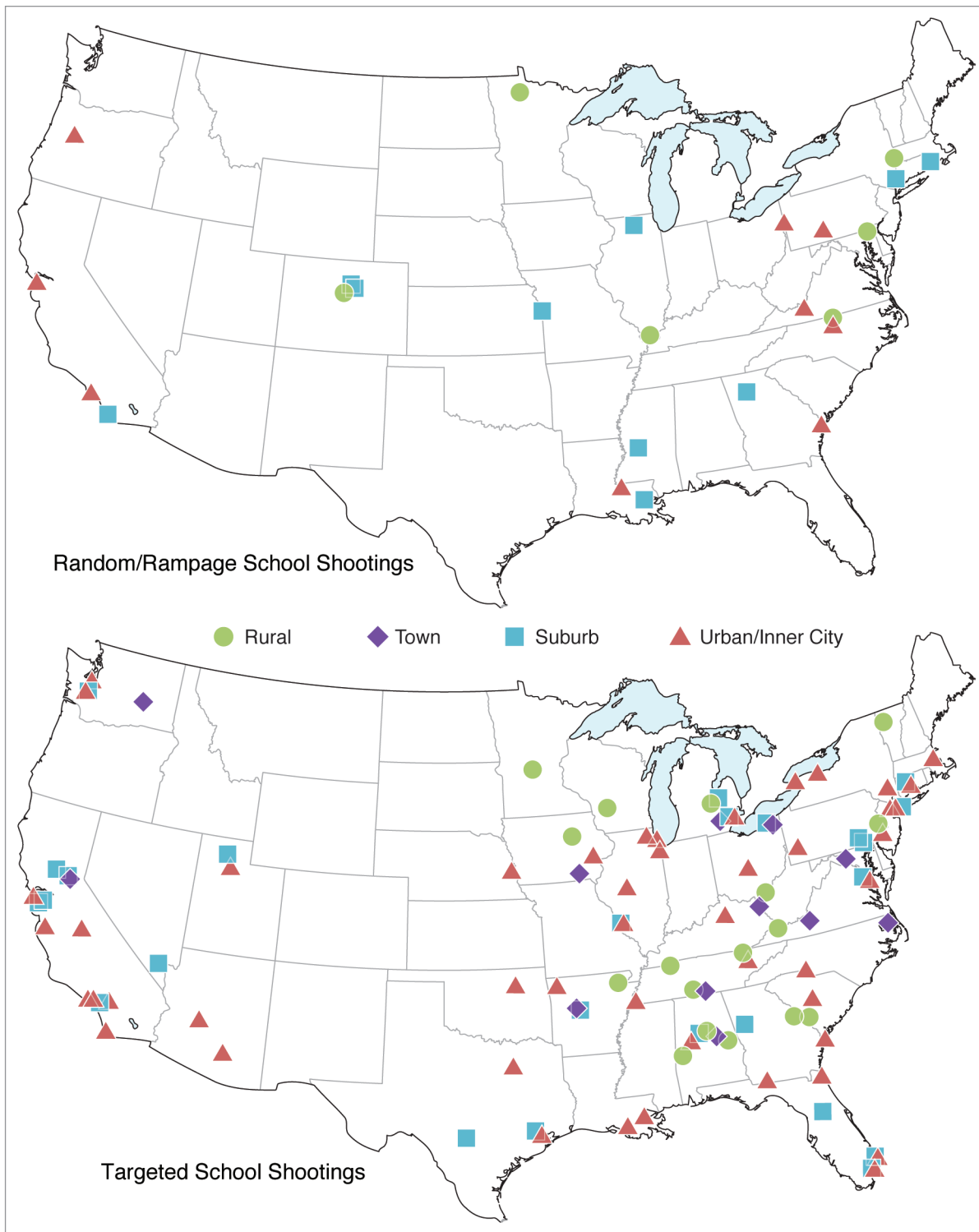
For 1990-2012, perpetrator characteristics were compared for random/rampage, targeted, and other school shootings (Table 9). Most shooters were male and young (mean age: 23.0 years) and half were current or former students in the school where the shooting took place, or in a nearby school. Fourteen percent of the 230 perpetrators committed suicide, including 37% of the random/rampage shooters.

**Discussion**

**Synopsis of findings**

This analytical exploration was set in motion by the tragic and horrific mass shooting at Sandy Hook Elementary School that captivated the nation and dominated the media throughout the 2012 year-end holiday season. We have written a commentary describing the synergistic features of this event that produced a “tipping point” phenomenon, generating a critical mass of focused attention.<sup>5</sup> While maintaining concentrated coverage on Sandy Hook, print and broadcast media periodically mentioned that this killing took place against a backdrop of high numbers of gun homicides and suicides that occur continuously and unceasingly every day, usually without receiving notice.<sup>69</sup> The present analysis was conducted to position the Sandy Hook massacre within the broader epidemiological context of gun violence in the U.S.

The key findings are: 1) the U.S. has the highest rates of firearm deaths among all developed nations; 2) annual firearm mortality exceeds 32,000 deaths, including 11,000 firearm homicides and



**Figure 7.** Geographic distribution of school shootings displaying urban/rural continuum, United States, 1990–2012. Upper map: random/rampage school shootings. Lower map: targeted school shootings.

almost 20,000 firearm suicides; 3) most firearm homicides—including those that occur in schools—are targeted, single-victim episodes; 4) rampage shooting massacres—whether in community or school settings—are rare and sporadic events; 5) random/rampage school shootings are different from targeted shootings

occurring in school settings in terms of: frequency (fewer), numbers of victims per episode (more), urban/rural geography (more suburban), and perpetrator characteristics, including perpetrator suicide on-scene; and 6) the sum of all deaths from all forms of shootings in a school setting—random/rampage, targeted, other—accounts

**Table 7.** Type of fatal school shooting incident in relation to level of educational institution.

Level of educational institution	Type of fatal school shooting incident							
	Random/rampage		Targeted		Other		Total	
	No.	%	No.	%	No.	%	No.	%
Elementary School	2	8.3%	14	10.4%	7	14.6%	<b>23</b>	<b>11.1%</b>
Middle School	1	4.2%	12	8.9%	8	16.6%	<b>21</b>	<b>10.1%</b>
High School	13	54.2%	82	60.7%	30	62.5%	<b>125</b>	<b>60.4%</b>
College/University	8	33.3%	27	20.0%	3	6.3%	<b>38</b>	<b>18.4%</b>
<b>Total</b>	<b>24</b>	<b>100.0%</b>	<b>135</b>	<b>100.0%</b>	<b>48</b>	<b>100.0%</b>	<b>207</b>	<b>100.0%</b>

**Table 8.** Type of fatal school shooting incident in relation to urban/rural continuum.

Urban/rural continuum	Type of fatal school shooting incident							
	Random/rampage		Targeted		Other		Total	
	No.	%	No.	%	No.	%	No.	%
Urban/Inner City	9	36.0%	80	57.1%	32	66.7%	<b>121</b>	<b>56.8%</b>
Suburban	10	40.0%	28	20.0%	10	20.8%	<b>48</b>	<b>22.5%</b>
Small Town	0	0.0%	14	10.0%	2	4.2%	<b>16</b>	<b>7.5%</b>
Rural/Agricultural	6	24.0%	18	12.9%	4	8.3%	<b>28</b>	<b>13.2%</b>
<b>Total</b>	<b>25</b>	<b>100.0%</b>	<b>140</b>	<b>100.0%</b>	<b>48</b>	<b>100.0%</b>	<b>213</b>	<b>100.0%</b>

for merely 0.12% (1/800<sup>th</sup>) of total firearm homicides and 0.05% (1/2000<sup>th</sup>) of total firearm deaths in the U.S.

**Analysis of firearm mortality and a note on firearm injury**

At the national level, from a public health vantage, firearms represent the lethal means by which more than 32,000 Americans die each year. Firearms are the method used in the commission of 70% of homicides and more than 50% of suicides. These deaths are human-generated acts of intentional harm to others (homicide) or intentional self-harm (suicide) and thus, these deaths are preventable. This echoes the viewpoint of Dr. Mark Rosenberg who helped establish the National Center for Injury Prevention and Control within the Centers for Disease Prevention and Control (CDC) and led the agency’s early gun violence research.<sup>70</sup>

Equally preventable is the toll of firearm injuries. According to the Institute of Medicine, “In 2010, more than 105,000 people were injured or killed in the United States as the result of a firearm-related incident.”<sup>19</sup> This figure includes 32,000 firearm deaths and 73,000 non-fatal firearm injuries, representing a ratio of 2.3 firearm injuries per firearm death. Moreover, in the twin tallies of the 12 deadliest mass shootings (Table 3) and the 12 deadliest school shootings (Table 4), the numbers of firearm injuries exceeded the numbers of firearm deaths.

The present analysis has focused on firearm mortality because national death data are available, reliable, complete, carefully verified at state and federal levels, meticulously analyzed by the National Center for Health Statistics, and consistently reported on an annual basis. Although outside of the scope of the current study, additional research on firearm injuries is clearly warranted, especially because of the high likelihood that such injuries may result in life-changing disability, disfigurement, paralysis, or brain damage.

**The special case of school shooting massacres**

The daily cadence of dozens of firearm suicides and single, targeted homicides that comprise the major burden of intentional death from firearms in the U.S. is periodically punctuated by a multiple-victim shooting massacre. Such mass shootings represent a relatively recent phenomenon in the U.S., dating from the middle of the Twentieth Century. In fact, half of the deadliest community- and school-based mass shootings have occurred since 2005. Sandy Hook Elementary School, Columbine High School, and Virginia Tech University are the most notable U.S. examples of a primary school, a secondary school, and an institution of higher education impacted by a tragic shooting massacre. These specific events are closely cross-referenced in media accounts.<sup>71-73</sup> Yet, despite the high visibility and notoriety of such acts, we have demonstrated that the numbers of incidents are few and the numbers of deaths represent a minute fraction of total firearm fatalities.

**International perspectives on prevention**

Considered in international context, the fact that the U.S. ranks first in gun ownership per capita; and first in rates of total firearm deaths, firearm homicides and firearm suicides among the 34 “advanced economies;”<sup>14</sup> is a powerful testament to the potential for prevention. Reinforcing this point of view, a just-published study examined gun ownership in more than two dozen “developed” countries, including the U.S., and concluded, “The number of guns per capita per country was a strong and independent predictor of firearm-related death in a given country.”<sup>74</sup>

The other 33 “advanced economies” of the world provide a cross-cultural spectrum of alternatives for achieving much lower rates of firearm deaths through a variety of strategies. These 33 case examples provide ample illustration that gun deaths, both suicides and homicides, can be limited. Indeed,



**Table 9.** Perpetrator characteristics by type of fatal school shooting, 1990–2012.

Perpetrator characteristics	Type of fatal school shooting incident							
	Random/rampage		Targeted		Other		Total	
<b>Total perpetrators</b>	<b>27</b>		<b>152</b>		<b>51</b>		<b>230</b>	
<b>Mean age</b>	<b>22.6</b>		<b>24.4</b>		<b>16.9</b>		<b>23.0</b>	
<b>Age group</b>	<b>No.</b>	<b>%</b>	<b>No.</b>	<b>%</b>	<b>No.</b>	<b>%</b>	<b>No.</b>	<b>%</b>
<18 years	9	33.3	52	34.2	13	25.5	<b>74</b>	<b>32.2</b>
18–24 years	11	40.8	29	19.1	11	21.6	<b>51</b>	<b>22.2</b>
25–34 years	2	7.4	15	9.9	0	0.0	<b>17</b>	<b>7.4</b>
≥35 years	3	11.1	23	15.1	0	0.0	<b>26</b>	<b>11.3</b>
Missing	2	7.4	33	21.7	27	52.9	<b>62</b>	<b>26.9</b>
<b>Gender</b>	<b>No.</b>	<b>%</b>	<b>No.</b>	<b>%</b>	<b>No.</b>	<b>%</b>	<b>No.</b>	<b>%</b>
Male	25	92.6	121	79.6	22	43.1	<b>168</b>	<b>73.0</b>
Female	2	7.4	3	2.0	1	2.0	<b>6</b>	<b>2.6</b>
Missing	0	0.0	28	18.4	28	54.9	<b>56</b>	<b>24.4</b>
<b>Perpetrator relation to school</b>								
Current Student	11	40.8	67	44.1	16	31.4	<b>94</b>	<b>40.9</b>
Former Student	6	22.2	8	5.2	0	0.0	<b>14</b>	<b>6.1</b>
Student from Other School	3	11.1	4	2.6	3	5.9	<b>10</b>	<b>4.3</b>
Employee/Teacher	0	0.0	12	7.9	0	0.0	<b>12</b>	<b>5.2</b>
Related to Student or School Employee	0	0.0	8	5.3	0	0.0	<b>8</b>	<b>3.5</b>
Boy/Girlfriend or Romantic Interest of Student or School Employee or Parent of Student	0	0.0	7	4.6	0	0.0	<b>7</b>	<b>3.0</b>
Unknown/Other	7	25.9	46	30.3	32	62.7	<b>85</b>	<b>37.0</b>
<b>Perpetrator suicide</b>								
Committed Suicide	10	37.0	22	14.5	1	2.0	<b>33</b>	<b>14.3</b>
No Suicide	17	63.0	130	85.5	50	98.0	<b>197</b>	<b>85.7</b>

among economically advanced nations, the U.S. is the odd case, the global outlier.

**Strategies to reduce the consequences of gun violence**

Our canvassing description of firearm mortality in America strongly supports the need to design a comprehensive package of solutions to address the complete spectrum of firearm fatalities. Already, steps have been taken toward these ends since the mass shooting at Sandy Hook Elementary School.

On January 16, 2013, The White House released, “Now is the Time: The President’s Plan to Protect Our Children and Our Communities by Reducing Gun Violence.”<sup>75</sup> On that date, President Obama introduced and signed 23 gun violence reduction Executive Actions,<sup>6,76</sup> a wide-ranging set of possible remedies compiled from the testimonies of hundreds of experts who appeared before the Gun Violence Task Force. These 23 Executive Actions were grouped into seven categories. Five actions aimed at strengthening the existing background check system, six dealt

with empowering law enforcement, two focused on making schools safer, and three encouraged responsible gun ownership. The remaining seven actions were clustered in three categories related to public health and health care services: improving access to mental health care (four actions), preserving the rights of health providers to protect their patients and communities from gun violence (two actions), and finally, a single Executive Action under the heading of “ending the freeze on gun violence research.” This rather provocative phrasing addressed the fact that CDC appropriations for gun violence research were slashed by 96% back in 1996,<sup>70</sup> purportedly in retaliation for a 1993 CDC study that showed a threefold higher rate of gun homicides in households with firearms.<sup>77</sup> The Executive Action on gun violence is captured in a single sentence, “Issue a Presidential Memorandum directing the Centers for Disease Control to research the causes and prevention of gun violence,”<sup>76,77</sup> accompanied by the following background statement:<sup>6</sup>

*There are over 30,000 firearm-related homicides and suicides a year. This fact makes it clear that gun violence is a public health crisis that merits the attention of top public health researchers. But for years, Congress has effectively placed a freeze on gun violence research. The Centers for Disease Control and Prevention and other scientific agencies are prohibited from using funds to “advocate or promote gun control,” and some members of Congress have claimed this ban extends to any research on the causes of gun violence.*

*Research on gun violence is not advocacy; it is critical public health research. So the President has taken action to immediately restart this important work and is calling on Congress to provide \$10 million to allow the CDC to conduct further research.*

As an immediate offshoot of this Executive Action, the CDC and CDC Foundation asked the Institute of Medicine (IOM) to convene a committee to define a research agenda that examines both the causes of firearm-related violence and possible interventions and strategies to reduce the public health burden. This initiative has already begun to pay dividends with the release of an initial IOM report in June 2013, entitled, “Priorities for Research to Reduce the Threat of Firearm-Related Violence.”<sup>19</sup>

Currently, with specific reference to the Sandy Hook shooting massacre, researchers in a variety of institutions are analyzing accessible data on gun violence and publishing findings.<sup>78</sup>

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## Concluding Discussion

Firearm violence is a preventable public health crisis. Public health and mental health can play central roles, infusing science and bringing a population perspective to the search for preventive interventions.

Infrequent but impactful mass shootings in school settings, like Sandy Hook Elementary, provide impetus and leverage to take action and search for solutions.<sup>5</sup> In the aftermath of this mass shooting, some of the remedies for healing that can unify and rally the American nation will focus on ensuring the safety of children from gun violence in school settings. This is imperative. However, the present analysis underscores the need to devise a comprehensive set of programs and policies that concurrently address the 99.8% of firearm homicides that occur outside of school settings, and the even larger number of firearm suicides.

Preventive interventions must be devised to mitigate the loss of life to firearm violence across the lifespan. Approaches must identify and address both the common, and the distinguishing, risk factors for firearm suicides and firearm homicides. Within the category of homicides, strategies must confront the mainstay of targeted, single-victim shootings as well as the rare, random, and sporadic rampage massacres in school or community settings.

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No potential conflicts of interest were disclosed.

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